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Multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals

Note by the Secretariat

The President of the Economic and Social Council has the honour to transmit to the high-level political forum on sustainable development the Co-Chairs' summary of the multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals, held in New York on 5 and 6 June 2018. The Co-Chairs of the forum, the Deputy Permanent Representative of Japan to the United Nations, Toshiya Hoshino, and the Deputy Permanent Representative of Mexico to the United Nations, Juan Sandoval Mendiolea, were appointed by the President of the Council. The summary is being circulated pursuant to paragraph 123 of the Addis Ababa Action Agenda (General Assembly resolution 69/313) and paragraph 70 of the 2030 Agenda for Sustainable Development (Assembly resolution 70/1).

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Co-Chairs' summary of the multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals

I. Introduction

1. The present summary represents a reflection of the broad discussions that took place during the multi-stakeholder forum on science, technology and innovation for the sustainable development goals). The summary brings together a diverse set of opinions articulated through both formal and informal statements provided by stakeholders. The views presented do not necessarily represent opinions held or endorsed by the Co-Chairs or the Governments that they represent.

2. Pursuant to General Assembly resolution 70/1, on 5 and 6 June 2018, the President of the Economic and Social Council, Marie Chatardová, convened the third annual multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals. As a component of the Technology Facilitation Mechanism, the forum is a venue to discuss cooperation in science, technology and innovation around thematic areas pertaining to the implementation of the Sustainable Development Goals, bringing together all relevant stakeholders to actively contribute in their areas of expertise. The forum provides a venue for facilitating interaction, matchmaking and the establishment of networks between relevant stakeholders and multi-stakeholder partnerships in order to identify and examine technology needs and gaps, including with respect to scientific cooperation, innovation and capacity-building, and to help to facilitate the development, transfer and dissemination of relevant technologies for the Goals and targets.

3. The Deputy Permanent Representative of Mexico to the United Nations, Juan Sandoval Mendiolea, and the Deputy Permanent Representative of Japan to the United Nations, Toshiya Hoshino, co-chaired the forum. The forum was prepared by the United Nations inter-agency task team on science, technology and innovation for the Sustainable Development Goals, with the support of the 10-member group of high-level representatives from civil society, the private sector and the scientific community.

4. The opening of the forum featured statements from the President of the Economic and Social Council, the Chef de Cabinet representing the Secretary-General, Maria Luiza Ribeiro Viotti, and the Under-Secretary-General for Economic and Social Affairs, Liu Zhenmin.

5. Three keynote speakers set the scene for the forum: Andrew Keen, author of *The Internet is not the answer*[1] and *How to fix the future*[2]; Noriko Arai, Professor, National Institute of Informatics, Japan; and Eric Garcetti, Mayor of Los Angeles, United States of America.

6. The forum was well attended, with an estimated 1,000 participants, representing Governments and scientists, innovators, technology specialists, entrepreneurs and civil society representatives — a broader participation than in 2017 and 2016. The forum comprised interactive sessions that engaged all stakeholders in the deliberations. In line with its mandate, the forum promoted networking and "matchmaking", including through an exhibition of innovative solutions for the Sustainable Development Goals; innovation pitches by practitioners; a special event on the first solar-powered aircraft to circumnavigate the world; a round table of

[1] London, Atlantic Books, 2015.
[2] London, Atlantic Books, 2018.

science, technology and innovation innovators, funders and other supporters; and 24 side events. It was convened back to back with the Global Solutions Summit, a special event of the Global Sustainable Technology and Innovation Conference, and several other events during the week.

7. The social media reach of the hashtags used for the forum, #Solutions4SDGs and #STIForum, was significant, with a reach of more than 3 and 13 million, respectively.

II. Highlights of the discussions at the forum

8. The forum deliberated on the challenges and technology solutions with transformative impact on each of the Sustainable Development Goals that are up for review at the high-level political forum in 2018: Goals 6, 7, 11, 12, and 15. The following, in particular, were discussed: the status of existing and new technologies; the potential for how science, technology and innovation could support the achievement of Goal 6 on water and sanitation; the main challenges for developing, adopting, disseminating or scaling renewable energy technologies (Goal 7); and the ways in which science, technology and innovation shape urbanization and development to create human settlements that are inclusive, safe, resilient and sustainable (Goal 11). Good practices and policy recommendations, as well as challenges and needs, were identified, with a view to facilitating the development, scaling up the adoption and dissemination of relevant technologies for sustainable consumption and production (Goal 12); and the role of science, technology and innovation in protecting terrestrial ecosystems (Goal 15), as well as in producing significant advances for other Goals, was discussed.

9. The forum also addressed global trends and cross-cutting issues, including the impact of rapid technological change on the achievement of the Sustainable Development Goals, pursuant to General Assembly resolution 72/242; national "science, technology and innovation for Sustainable Development Goal road maps" for the Goals and capacity-building; local and indigenous knowledge and home-grown innovations for the achievement of the Goals; and next steps for the Technology Facilitation Mechanism. An interactive dialogue with the 10-member group of high-level representatives, newly appointed by the Secretary-General for the period 2018–2019, was an opportunity to engage on their vision for the Mechanism.

10. Selected messages and highlights of the forum are presented in the remainder of the present summary.

11. Statements and presentations in the opening session laid out "big-picture" views of key issues, principles and policy responses, many of which were further elaborated on in later sessions.

Impact of rapid technological change on the achievement of the Sustainable Development Goals

12. Pursuant to General Assembly resolution 72/242, the Assistant Secretary-General for Economic Development and Chief Economist of the Department for Economic and Social Affairs, Elliott Harris, presented the initial findings of the Technology Facilitation Mechanism on the impact of rapid technological change on the achievement of the Sustainable Development Goals.[3] These preliminary findings, documented in an information paper by the inter-agency task team,[4] represented a

[3] Available from https://sustainabledevelopment.un.org/content/documents/27061ASG_Session_1_STIF_2018_Copy.pdf

[4] Available from http://sustainabledevelopment.un.org/tfm.

collaborative, multi-stakeholder effort with well over 100 expert contributors, including diverse stakeholders such as the International Council for Science and the major group on children and youth. They synthesize the evidence and conclusions from eight meetings and sessions under the umbrella of the Technology Facilitation Mechanism;[5] 10 recent United Nations system reports and publications; written inputs from the 10-member group and from the inter-agency task team, comprising 36 United Nations entities; and 39 science-policy briefs. The Vice-Chair of the Commission on Science and Technology for Development, Peter Major, also presented an overview of the Commission's deliberations at its twenty-first session, held in Geneva from 14 to 18 May 2018, including a response to General Assembly resolution 72/242, which are presented in detail in the report of the Commission.

13. Digital technologies, robotics, artificial intelligence and automation, biotechnology and nanotechnology all have fundamental and far-reaching impacts and present opportunities and challenges, in respect of the economy, society and environment and can already be felt in all countries.

14. These new technologies hold great promise for the Sustainable Development Goals. They could help eradicate poverty; bring high-quality education to all; help find cures for intractable diseases; expand mankind's knowledge base; significantly improve resource efficiencies; improve governance, accountability and inclusion; and make a fully renewable, circular economy possible, thus fostering an era of abundance and cooperation rather than scarcity.

15. However, there are also concerns about negative impacts. Benefits are not evenly distributed and unanticipated adverse consequences occur.

16. Artificial intelligence, the Internet of things and other technologies could further exacerbate wealth inequalities between rich and poor, and this could cause mass unemployment, strains on governance systems and reduced privacy and freedom, despite greater connectivity and empowerment of civil society.

17. There are technology gaps between and within countries; between men and women; and across social groups. These gaps often correspond to differences in infrastructure, access and capacities.

18. We need to act proactively towards the objectives and targets of the 2030 Agenda and its aspiration to leave no one behind. Systemic changes are needed, including in educational and training systems, skills and creative capacities.

19. Rapid technological change presents policy challenges that call for a stronger level of international cooperation. Many countries may need to find new kinds of development pathways that incorporate these technologies and that require a rethinking of patterns of employment and income.

20. Better knowledge and understanding of trends is needed for sound public policies and actions.

21. Calls for a more responsible and ethical deployment of technologies have to be balanced against restraints on innovations that may deprive humanity of many benefits. These ethical considerations must derive from our shared vision — the values contained in the Charter of the United Nations, the Universal Declaration of

[5] The most recent of these inter-agency task team expert group meetings was organized by the Department of Economic and Social Affairs, the Economic Commission for Latin America and the Caribbean and the United Nations Conference on Trade and Development in Mexico City on 26 and 27 April 2018. The conclusions and recommendations of the expert group meeting on rapid technological change, artificial intelligence, automation and their policy implications for sustainable development targets are available from http://sustainabledevelopment.un.org/tfm.

Human Rights and, most recently, in the 2030 Agenda and the Addis Ababa Action Agenda of the Third International Conference on Financing for Development.

22. Governments should fund science education and build the capacity of the next generation, in particular women and youth. The private sector has a positive role to play in building productive capacities in developing countries. Local capacity and appropriate regulatory frameworks are needed if domestic firms are to adopt and adapt technology, as well as to develop domestic technologies, innovative ideas and developing sustainable solutions to tackling global challenges.

23. The awareness of policymakers needs to be raised in terms of the potential effects of accelerating technological change, and viable technology strategies should be elaborated in each country. Inclusivity and trust building is needed, as is participation of scientists in finding solutions for the Sustainable Development Goals. The United Nations could provide support through capacity-building and collection and dissemination of information and best practices. In this context, reference was made to the Technology Bank for the Least Developed Countries, as well as to the idea of an African science, technology and innovation forum and platform for research and information exchange.

24. These discussions have been ongoing at the forum since 2016 and are likely to continue at the science, technology and innovation forum and other forums at the regional and national levels. The Technology Facilitation Mechanism is encouraged to continue its work in this regard, building on its initial findings. Updates should also take into account inputs from scientists, economists, academics, businesspersons, high-level public officials and other experts, including those from relevant United Nations agencies, in line with the prevailing practices since 2016. In addition, the United Nations should assess and help countries with identifying and facilitating the implementation of good practices and public policy responses related to the Sustainable Development Goals, so as to mitigate the potential negative effects and harness the potential of rapid technological change.

National science, technology and innovation for Sustainable Development Goal road maps and capacity-building

25. The challenge is to design science, technology and innovation policies and instruments for the Sustainable Development Goals that translate the Goals' universality principle into actions, while respecting national science, technology and innovation priorities and realities. Science, technology and innovation for Sustainable Development Goal road maps for the Goals can be important strategic tools for ensuring policy coherence and for linking the most pressing development challenges with solutions. Such road maps are needed, ideally with measures for tracking progress.

26. A number of lessons have been learned from such national plans, policies and road maps. The cross-cutting nature of the Sustainable Development Goals and of science, technology and innovation requires holistic approaches and strategies. Multidisciplinary, integrated approaches are necessary. They should take into account different sources of knowledge, including traditional knowledge.

27. It is important to improve science ecosystems and to involve all relevant stakeholders in science, technology and innovation policy design, adaptation and application. Collaboration should be fostered among scientists, engineers, companies, public research and government institutions and the end users of technological products.

28. Science and technology advisory systems should be engaged in all areas related to the implementation of the Sustainable Development Goals and be independent of

day-to-day politics. Cross-goal cooperation across sectors should be rewarded and policy instruments operationalized.

29. Science technology and innovation for Sustainable Development Goal road maps need to be customized to fit countries' circumstances and at the same time be harmonized worldwide to structure the necessary knowledge and match problems with solutions.

30. Several countries shared their experiences emphasizing the role of science, technology and innovation as a central element of national development strategies, policies, and programmes. Jamaica had adopted and resourced Sustainable Development Goals as an integral part of its national development plan, being implemented in a multi-sectoral, cross-ministerial and inter-generational manner, linked directly to science, technology and innovation. Japan had promoted the vision of a human-centric and inclusive "Society 5.0" to create opportunities in physical and cyber space to leave no one behind, and it was promoting science, technology and innovation for Sustainable Development Goal road maps in international policy dialogues in 2019 through its presidency of Group of 20 (G-20) meetings and taking advantage of the seventh Tokyo International Conference on African Development. Ghana emphasized the importance of aligning such road maps with national development strategies and capacity-building at tertiary school for women. The strategic development programme Georgia 2020 fully integrated science, technology and innovation, through reforming financing for higher education and research and strengthening international research collaboration and through innovation ecosystems. Chile sought to bring together technological capabilities in a resilience institute for natural disasters.

31. Global partnerships are essential. Strengthened partnerships are needed between the private sector, academia, non-governmental organizations and young people. High-priority actions for these partnerships include global cooperation on science-policy interfaces, human capacity-building, multi-disciplinary innovations and massive data-processing and information technology platforms in support of the Goals. One example of such a platform is the Tropical Agriculture Platform — a G-20 initiative led by the Food and Agriculture Organization of the United Nations (FAO) — which aims to improve agricultural innovation capacities needs at individual and institutional levels within the fragmented agricultural innovation systems.

32. Some suggested that adopting a global public goods view of publicly funded research could go a long way to finding cooperative solutions to the most pressing international Sustainable Development Goal challenges.

33. Further international support, Member State engagement, and partnerships with donors and the private sector will be needed to fill the critical gaps in data, finance and effective implementation.

34. National science, technology and innovation for Sustainable Development Goal road maps can be a significant output of the Technology Facilitation Mechanism. They can help decision makers in government and civil society, as well as members of the public — from heads of State and finance ministers to citizens at the local level — to evaluate how the nation's policies, investments and actions are achieving the intended outcomes efficiently and effectively. United Nations experts in the inter-agency task team, the 10-member group and among Technology Facilitation Mechanism stakeholders constitute an important source of expertise, as well as technical and financial support, which should be effectively mobilized.

35. Several inter-agency task team partners, most notably the World Bank, are currently exploring means and ways of better supporting science, technology and innovation for Sustainable Development Goal road maps.

Realizing the potential of local and indigenous knowledge and home-grown innovations for the achievement of the Sustainable Development Goals

36. Important synergies can be realized between traditional, local and indigenous knowledge on the one hand and modern scientific knowledge on the other, leading to accelerated progress towards the Sustainable Development Goals.

37. Local and indigenous knowledge is not static, but dynamic and innovative. It is a dynamic system that is in practice enriched by other sources of knowledge. Co-production of knowledge is typically an important source of innovation.

38. Traditional knowledge has distinguishing features, in that it is acquired through interaction with the land and that its very objective is to ensure survival. Culturally relevant tools are available that enable data collection from indigenous peoples and the promotion of community-driven research.

39. Local and indigenous knowledge has an important role in addressing complex global issues, such as biodiversity loss, weather risks, climate change, and desertification. However, conducive conditions and partnerships are needed to mobilize such knowledge.

40. Examples presented illustrated how traditional knowledge systems can be combined and integrated to complement scientific knowledge. Pastoralists in the Horn of Africa demonstrate how communities make critical livelihood decisions on the basis of sophisticated, systematic observations of the natural systems, coupled with information from weather services. Inuit foraging practices shed light on changing animal diets, driven by broader systemic changes. Brazil has a regular national dialogue with indigenous people. Mexican indigenous women use solar energy to produce organic honey. The United Nations Educational, Scientific and Cultural Organization (UNESCO) combines indigenous knowledge with science.

41. Scaling-up and adapting local and indigenous knowledge and making it accessible to policymaking often requires support — from partners, Governments and the international community.

42. All relevant knowledge systems should have a voice at the science, technology and innovation forum. Also, local and indigenous knowledge should be considered in the deliberations of the Technology Facilitation Mechanism on cross-cutting themes such as science, technology and innovation for Sustainable Development Goal road maps.

Science, technology and innovation for sustainable management of water and sanitation for all (Sustainable Development Goal 6)

43. Access to clean water is a crucial foundation for poverty eradication and sustainable development. Today, over 2 billion people drink unsafe water and have to walk long distances to access water services, and more than 4.5 billion people do not have safely managed sanitation services. Worldwide, water demand is projected to grow by over 40 per cent by 2050, with two thirds of the world's population living in water-stressed countries by 2025. At the same time, climate change contributes to increased variability in the amount of rain and in its pattern, which makes water one of the most significant factors affecting the social, economic and environmental dimensions of sustainable development.

44. In this regard, new materials, digital technologies, biotechnologies, nanotechnologies and artificial intelligence hold great promise for the development of a range of high-efficiency water systems. There are promising small-scale applications of these technologies in the context of developing countries, and there is a need to identify mechanisms to ensure the scale-up of these projects.

45. The United Kingdom of Great Britain and Northern Ireland promotes mechanisms that require partnerships between the public and private sectors and the forum noted several successful projects that harnessed the private sector to address water-related development needs, including rainfall tracking in African countries and supporting innovation in water quality testing in Bangladesh. Colombia is creating a partnership among government, universities, and the private sector, and local communities are critical for the design and implementation of rural and community-operated aqueducts and sewage systems.

46. There is also a need to invest in science, technology and innovation and data to help better understand the role of water in the economic, environmental, social and political dimensions. For example, satellite data are used for meteorological modelling, and the forum noted that such data had been used to produce the Africa Groundwater Atlas, an online resource that brings together high-quality data from 51 countries for new hydrological maps for Africa to help inform planning. Internet-of-things-related devices such as sensors, meters and mobile phones could also play a critical role in future water efficiency management. Particular attention must also be paid to technology to monitor and collect data on water consumption patterns in order to better accommodate user trends.

Science, technology and innovation for access to affordable, reliable, sustainable and modern energy for all (Sustainable Development Goal 7)

47. Affordable access to essential services underpins development. Energy fuels many such services and, to provide services to current and future generations, the energy system itself needs to be sustainable. This energy system may impact and interact with the economy, society, and the environment, including other physical resource or commodity systems. The effects of this impact and interaction need to be managed sustainably. There are multiple benefits of applying a holistic approach to tackling energy, climate, water, health and mobility challenges and building synergies between Sustainable Development Goal 7 and other Goals.

48. Universal energy access can be achieved. Progress in this area would require the upgrading and the extension of the energy grid to underserved areas, as well an integrated approach to support off-grid, mini-grid and grid solutions to bring electricity services to areas without access to electricity. The costs of renewable energy technologies have fallen dramatically, and there has been a rapid increase in the deployment of such technologies combined with new business models. Furthermore, convergence between electricity and information and communications technology (ICT) can contribute to increasing access to affordable, reliable, sustainable and modern energy for all.

49. Investment in new and efficient energy supply and end-use technologies needs to be promoted by policy frameworks and de-risking strategies. Policy instruments should give stability and predictability to often substantive initial investments by the private sector. Furthermore, investment in research and development needs to increase and must be accompanied by the vigorous promotion of capacity-building and education. Support for local capacity-building is essential, especially for young practitioners to learn about renewable energies and new business models. To tackle climate change, the development of renewables should also be complemented with carbon policies, including carbon prices and reforms in fossil fuel subsidies.

50. While technologically advanced products such as electric cars would soon become more affordable and available, commercially available technology should continue to be promoted. Examples from Brazil, such as the "RenovaBio policy", show that biorefinery has significant potential to be deployed on a mass scale with decarbonization of transport through ethanol use. However, such approaches need to

balance impacts on land use, which could be detrimental to the overall objectives of the 2030 Agenda.

51. The forum noted several examples of international cooperation in the promotion of science, technology and innovation for Sustainable Development Goal 7, including the Horizon 2020 Programme of the European Union and the Mission Innovation initiatives, and a Swedish project in India to provide clean water.

Science, technology and innovation for inclusive, safe, resilient and sustainable cities and human settlements (Sustainable Development Goal 11)

52. The scale and nature of human settlements at the beginning of the twenty-first century is unprecedented. Globalization, industrialization and urbanization have led to the rapid growth of cities worldwide. In 2015, close to 4 billion people, or 54 per cent of the world's population, lived in cities, and that figure is projected to increase to about 5 billion by 2030. Rapid urbanization has brought enormous challenges, including growing numbers of slum dwellers, increased air pollution, inadequate basic services and infrastructure and unplanned urban sprawl, which also make cities more vulnerable to disasters. Better urban planning and management are needed to make the world's urban spaces more inclusive, safe, resilient and sustainable.

53. At the same time, cities are innovation hubs and regions of high population density. Thus, they are at the centre of tackling the Sustainable Development Goals through technology. Enhancing the quality of life in the urban world would have a broader impact, spilling over into other Goals, beyond Goal 11.

54. For example, disease, depression and other concerns are by-products of poor urban conditions. Public health initiatives in urban settings must address those concerns and matters related to changing the sensory design landscape. In smart cities, sensory design and their delivery systems should promote wellness. To adapt to a denser population, any technology that is introduced to address a range of concerns, from high noise levels to air pollution, must be safe and preserve the privacy of individuals. To be successful, policy experts need to become familiar with the nature and experience of the science and technology that are shaping cities. They need to wield this science and technology with the same "savvy" as the scientists and engineers who discover and invent them.

55. Another example is the way in which innovations in cities that promote public transportation and cycling could respond to climate change concerns. Tackling climate change in an integrated manner is one of the most critical drivers for science, technology and innovation. Therefore, it is crucial for Technological Facilitation Mechanism partners to support and engage in the implementation of the outcomes of the Cities and Climate Change Science Conference of the Intergovernmental Panel on Climate Change.

56. The rise of digital infrastructure and "smart cities" technology is providing public administrations with new ways to monitor and respond to urban challenges and conditions, as well as to contribute to the transformations required for achieving the Sustainable Development Goals. Smart cities involve infrastructure and the technology needed for its predictive maintenance. In this regard, data has become essential and has revolutionized our ability to monitor the physical infrastructure. The forum noted several examples of smart cities initiatives and of policies to support Member States in their efforts to achieve the Goals in cities, including in Argentina and Japan, and by the International Atomic Energy Agency. While the first wave of smart cities had experienced some success, inspiring future approaches, continued progress would require the use of data in new ways and the harnessing of emerging technologies to enhance further developments. At the same time, algorithms should be transparent and open to criticism to ensure useful results.

Science technology and innovation for sustainable consumption and production patterns (Goal 12)

57. Decoupling economic growth from natural resource use is fundamental to sustainable development. A circular economy approach, combined with modes of sustainable consumption and production, could improve the sustainability and resilience of the whole global socioeconomic system.

58. Food and agriculture are sectors that face enormous challenges concerning sustainable production and consumption. In developing countries, one third of the food produced is lost in production and transportation, while in developed countries 40 per cent of food is lost in retailing. Governments should promote evidence- and science-based approaches to reduce food loss and waste and implement policy innovations and reforms for sustainable and nutritious diets, including reforming subsidies, as well as taxes on emission-intensive foods.

59. Micro- and informal enterprises play an essential part in the production and consumption fabric, in particular in developing countries. They have innovation and technology diffusion potential that should be taken into consideration in the promotion of science, technology and innovation for sustainable consumption and production. Efforts must target poor communities, scale up partnerships and promote science and technology through doing, using and acting.

60. The forum noted examples such as Climate-KIC, a joint European climate innovation movement that addresses the climate innovation challenge of curbing emissions collaboratively, looking at systematic innovation. Consumption and production patterns can also be made more sustainable by creating new efficiencies in existing models by crowd-based incentives or technologies such as blockchain, or by creating new economic models such as "shared access consumption" or crowd-based capitalism.

61. It is critical to promote a change towards more sustainable consumption patterns and engage young people and children in this change. Participants also noted the importance of supporting bottom-up approaches, encouraging urban agriculture, introducing regulations and examining the future of work and jobs concerning Sustainable Development Goal 12.

Science technology and innovation for the sustainable use of terrestrial ecosystems (Sustainable Development Goal 15)

62. Biodiversity and ecosystems are essential for the survival of current and future generations. The targets of Sustainable Development Goal 15 encompass various aspects of "life on land", ranging from freshwater and mountain ecosystems to biodiversity, desertification, land degradation and benefit-sharing from genetic resources. The role of science, technology and innovation in achieving Goal 15 is related not just to those initiatives that directly relate to its targets, but also to those that can produce significant advances for other Goals, with limited additional impact on terrestrial ecosystems.

63. For example, agricultural and mining systems need restructuring and should become more sustainable, as they are significant contributors to the degradation of ecosystems and land and biodiversity loss. Small-scale food systems and landscapes could help to feed the world, as well as conserve biodiversity, local and indigenous knowledge and systems. In the mining sector, a priority area that has been identified is the development of mining and biodiversity guidelines to inform decision-making.

64. Science and technology should be used to understand and learn from nature and to build capacity and infrastructure for the transfer of technology to the grass-roots level for immediate utilization. Significant progress is possible through improving

and scaling up existing technologies, including: remote sensing for land use, planning and monitoring; locally applicable soil conservation methods; citizen science; and community-based monitoring. The "big data" revolution can be harnessed to monitor the state of health of natural capital, in a transparent and accountable manner, including through ecosystem accounting.

65. To increase ecosystem resilience and ecosystem restoration and to solve problems such as drought and desertification, a people-centred approach and multi-stakeholder involvement are required. An especially important consideration is that of working with local communities, including indigenous peoples, to support the ways in which they may be applying local and indigenous knowledge towards attaining these targets.

66. Biodiversity is the living fabric of the planet, and its rapid decline threatens nature and people. The forum stressed the need for bioethics and ethics in genetic technologies, such as changes in DNA that impact biodiversity, ecosystems and species. Regulation is needed to ensure responsibility and accountability for decisions regarding technologies that can have a potentially adverse effect on humans and biodiversity.

Supporting the implementation of the Technology Facilitation Mechanism

67. Interest in and demand for the Technology Facilitation Mechanism and its components has continued to increase over the past year. The forum commended recent progress in the work of the inter-agency task team and the 10-member group.

68. In particular, the forum welcomed the launch of a prototype of the Technology Facilitation Mechanism online platform, as mandated by the 2030 Agenda, which was presented during an inter-agency task team side event. Similarly, it welcomed the joint capacity-building initiative of the inter-agency task team, which recently pooled science, technology and innovation-related training materials and expertise and organized an inter-agency task team training workshop in Amman, from 15 to 19 April 2018.[6] Increased support is needed from donors and stakeholders, in order to have a fully operational online platform and to systematically close capacity development gaps. The online platform should become a main depository of science, technology and innovation knowledge, including with the support of the United Nations system.

69. Political and scientific leadership and adequate resources are essential. There were calls for longer-term funding for the Mechanism at a level that is commensurate with the goal of delivering on the expectations of Member States and other stakeholders. More broadly, funding for science, technology and innovation for the Sustainable Development Goals is crucial. At the same time, the existing funding landscape is highly diverse and fragmented.

70. The 2018 science, technology and innovation forum recognizes that existing conferences and events in the United Nations system, and beyond, advance the objectives of the Technology Facilitation Mechanism and that their inclusion strengthens the forum. Outcomes of such events and related initiatives in support of the science-based, solution-oriented, multi-stakeholder and collaborative Technology Facilitation Mechanism were presented. It was also discussed how to optimize the impacts of the Mechanism and how to make Mechanism co-operations self-sustaining.

71. Appropriate arrangements should be made so that stakeholders including global science communities and civil society can be further engaged in the planning and follow-up of the forum, building on institutionalized mechanisms and intersessional dialogue in online and offline formats.

[6] Available from www.unescwa.org/events/workshop-innovation-policies-sdgs-arab-region.

72. The Mechanism's intersessional work should build links to and encompass important science, technology and innovation-related events and conferences, in order to amplify the scope of the forum and draw on diverse stakeholder communities, while also facilitating their interlinkages, synergies and mutual support. Examples include the Global Solutions Summit, the Global Sustainable Technology and Innovation Conference, the International Telecommunication Union (ITU) Artificial Intelligence for Good Global Summit and events on a broad range of science, technology and innovation issues with the support of UNESCO, the Organization for Economic Cooperation and Development, among others. An inter-agency task team example is the workshop on science, technology and innovation for the Sustainable Development Goals, held in Incheon, Republic of Korea, from 29 November to 1 December 2017, which supported preparations for the forum. A thematic example is the FAO Agricultural Innovation Symposium for Family Farmers, to be held in Rome, from 21 to 23 November 2018, which aims to promote increased investments in family farmer-friendly agricultural innovation and is envisioned as a direct contribution to the forum and the United Nations Decade of Family Farming.

73. It was requested to further expand membership of the inter-agency task team to include all relevant United Nations system entities and to consider pursuing partnerships with stakeholders and organizations mobilized by the 10-member group. Stakeholders were also encouraged to make contributions to the work streams of the inter-agency task team, such as those on the online platform, on the science, technology and innovation for Sustainable Development Goal road maps, on assessment of the impacts of rapid technological change on the Goals and capacity-building.

74. Despite deeper and more widespread cooperation among different actors of the science, technology and innovation community, there remains a lack of coordination and communication at the national, regional and global levels. There are no central authorities, ministries or focal points that would support all aspects of technology deployment. For joint action, numerous actors need to be brought together, and the roles of the United Nations, Governments, development institutions, funding agencies, science academies, the private sector, civil society and other stakeholders need to be agreed in each country context.

75. Capacities need to be built, not only for research and development and for specific technology solutions, but, most crucially, for practical deployment of technology solutions on a large scale. Similarly, technology management capacities are essential for identifying economically affordable, environmentally sound and socially acceptable new technologies.

76. "Systems thinking" and cross-sectoral cooperation are important for the identification of technological solutions for Sustainable Development Goal implementation. One such example is wastewater treatment, whereby, traditionally, an expensive process could be turned into a resource for energy production and nutrients if the right solutions were used.

77. Panellists suggested that Governments are not giving science, technology and innovation adequate focus in their Sustainable Development Goal implementation, as evidenced by the lack of references to technology in the voluntary national reviews and the nationally determined contributions reports.

78. Access to and equal benefits from new technologies are important. It was noted, for example, that reporting against 40 per cent of the Sustainable Development Goal indicators could be dramatically improved through access to space technology. Space technology can be used for improving urban transport flows, tackling deforestation, measuring and mitigating climate change, inter alia, but many countries are still not

benefiting from these technologies and data. The issue of the social acceptability of technologies also needs to be addressed.

Round table of science, technology and innovation innovators, funders and other supporters

79. The round table examined how to leverage frontier technologies, including by women and youth, in order to deliver impact investing and prosperity for all. It discussed ways to develop and pilot technology solutions for the Sustainable Development Goals and to support the enabling policies that may be needed for taking these to scale. It also discussed the potential social impact of blockchain technology in achieving financial inclusion and preventing human trafficking.

80. The round table defined "impact investment" as an investment with both a social purpose and a financial return. It claimed that working towards the Sustainable Development Goals represented the largest business opportunity in the world.

81. Businesses presented their work on science, technology and innovation for the Sustainable Development Goals. The fintech fund, CreditEase, for example, provides peer-to-peer lending and wealth management in China. Rakuten works in e-commerce and partners with small businesses. Incubate Fund makes investments in start-ups that service small consumer groups, such as seniors. Syneidesis is a family office that brings together deals on a scale of one to five million United States dollars. IMPACT Leadership 21 educates people about the Sustainable Development Goals and the viability of impact investment. Rising Tide Capital supports entrepreneurial capacity-building in economically depressed urban areas and communities in cities.

82. The round table recommended ways to make impact investing more attractive for investors: coupling with advisory services; gearing sustainable financial products to retail investors to make them more accessible; educating people, especially young people, about impact investment in sustainable businesses and about technological changes; and working towards the financial inclusion of women.

Exhibition and young innovators

83. An integral part of the forum was an exhibition hub. This featured the winners of a global call for innovations, as well as a showcase of corporate solutions for the Sustainable Development Goals, and a set of posters from research institutions. These innovations, selected from around the world, had to be transferable, inspiring and impactful.

84. The exhibition was launched through a special event. The innovations addressed technologies to improve water purification systems (Goal 6), promote cleaner cooking fuels (Goal 7), rethink urban waste management (Goal 11), and advance sustainable consumption and production by repurposing "ugly" fruits and vegetables that would otherwise be wasted (Goal 12), inter alia. Software company Qlik showcased the use of their data analytics for Sustainable Development Goal tracking and smart city applications. National laboratories and other institutions presented themselves by means of posters.

85. The following are short descriptions of the winners of the global call for innovations who pitched their solutions to the forum. The Jiko Raha innovation from Kenya is a fuel-efficient biomass stove that enables households to have safe drinking water, insulates the stove and makes it more efficient.

86. The Inga Foundation's alley cropping is a scientifically proven solution to stopping the devastation of tropical rainforests. It regenerates land and transforms the lives of subsistence farmers, providing food security and organic cash crops, as well

as reducing carbon dioxide emissions, protecting wildlife and marine habitats and preserving water sources.

87. The Maji Mamas innovation enables women to build scalable water construction micro-franchises. They use interlocking stabilized soil block technology to make environmentally sustainable tanks for less than half the cost of those of the cheapest competitors on the market, increasing their income and bringing water management solutions to their communities. They receive training in business, leadership and water and sanitation issues, in order to build and expand on a scalable plan.

88. Ocupa tu Calle from Peru uses small-scale urban interventions to improve the quality of urban life, promoting the recovery of disused public spaces. It promotes collaboration between local governments, academic institutions, the private sector and civil society; generates knowledge; and advises municipalities.

89. ATEC* Biodigesters International produces, sells and distributes a commercially scalable biodigester that can reach all "last-mile" households. Utilizing animal, green and human waste, each system produces renewable biogas for daily cooking, 20 tons of organic fertilizer per year and $5,850 household savings over its lifetime.

90. An innovation from India in sustainable, effortless and low-cost drinking water systems is based on a speciality polymer that removes viruses, bacteria, turbidity, pathogens and iron to purify water without chemical treatment. It requires no energy source or electricity. It has a long life and can be easily maintained.

91. The SweetSense innovation creates Internet-of-Things solutions to improve the quality and value of water, sanitation and energy services in emerging markets. Groundwater sensors indicate the runtime of each groundwater extraction pump, reporting daily over satellite or cellular networks to a central dashboard accessed by water service providers.

92. The City Based Common Hospital Waste Treatment facility in Nepal offers a solution for biomedical waste, prioritizing health and the environment and focusing on non-burn technology and a city-based common treatment facility.

93. The FoPo Food Powder project from the Philippines aims to re-engineer the future of food by turning $1 trillion worth of food waste into an opportunity. It has processed over 7 tons of fruit and vegetables that would otherwise have been wasted, thereby reducing CO_2 emissions and saving water.

94. The Education for Sharing initiative gives children between the ages of 6 and 12 years a hands-on approach to science, technology, engineering and mathematics, to make them accessible, relevant and interesting. Through games and experiments, they learn about civic values and the Sustainable Development Goals.

95. PetaBencana from Indonesia is a free, web-based platform that produces megacity-scale visualizations of disasters in Indonesia, using both crowdsourced reporting and government agency validations in real time. It democratizes decision support and increases the safety and resilience of cities.

Side event highlights

96. Stakeholders of the scientific and technological community, in cooperation with Member States, international organizations, and other stakeholders, organized 24 side events and some special events — the Global Solutions Summit, a Global Science, Technology and Innovation Conference event — on a broad range of science, technology and innovation issues. Most of these events focused on questions regarding the role of science, technology and innovation in achieving the Sustainable Development Goals; on energy, water, cities, biodiversity and climate change; or on new technological advances in artificial intelligence, biotechnology or the fourth industrial revolution.

97. Water Youth Network discussed local and indigenous knowledge. Urban Catalyst Lab highlighted case studies on best practices of stakeholders (e.g., the International Federation of Red Cross and Red Crescent Societies, the United Nations Human Settlements Programme, the Urban Risk Lab at the Massachusetts Institute of Technology, the city of Atlanta, Microsoft) on the use of technologies to promote resilience. The United Nations Industrial Development Organization and ITU addressed the fourth industrial revolution. The International Institute for Applied Systems Analysis, the United States National Academy of Engineering, the International Council for Science and the World Federation of Engineering Organizations discussed pathways and a road map for transforming systems of energy, consumption and production, food and the biosphere, cities and new technologies for sustainable development (The World in 2050 initiative). Future Earth discussed science, technology and innovation solutions in cities. The children and youth major group discussed intergenerational capacity-building solutions for the Sustainable Development Goals. The Fair Air Coalition explored Earth system processes, planetary boundaries and circular economy ideas. UNESCO addressed collective efforts towards Goal 15. The International Council for Science and several African research institutions shared research experiences on sustainable urban development. ITU provided insights from the ICT community. The science, technology and innovation and disaster risk reduction communities came together to share innovative success stories to prevent disasters. UNESCO, K-water, W-Smart and the Government of the Republic of Korea showcased advanced technology applications for water conservation and improved services at lower distribution costs. The Stakeholder Forum for a Sustainable Future highlighted nexus technologies for smart, sustainable cities. The inter-agency task team reported on its new joint capacity-building programme and invited contributions in order to scale up the initiative. The Office of Information and Communications Technology, the Department of Economic and Social Affairs, the World Intellectual Property Organization and the United Nations Framework Convention on Climate Change presented a prototype of the Technology Facilitation Mechanism online platform and solicited comments and suggestions for its future development. The United Nations innovators network presented its work.

III. Key messages and general recommendations

98. The forum highlighted many practical examples and proposed recommendations for action by the United Nations system, Governments, businesses, scientists, academia, civil society and others. The necessity of a multi-stakeholder approach was repeatedly underscored. The following issues stand out and are suggested for consideration by decision makers. The forum also proposed a wide range of solutions and recommendations on how to address the challenges in Sustainable Development Goals 6, 7, 11, 12 and 15 (see sect. II above).

Science, technology and innovation for the Sustainable Development Goals

99. Many insights have been gathered towards Sustainable Development Goal-specific solutions, including those that help to manage trade-offs and realize synergies. Attention should now move to addressing bottlenecks in their scaling up, dissemination and adoption. These should be discussed at the 2019 forum, with a view to informing the global follow-up and review to be convened under the General Assembly in that year. A report capturing the way forward by the Technology Facilitation Mechanism would help guide Member States in their deliberations in that year.

100. The online platform, as mandated by the 2030 Agenda, is now at a stage where it could start delivering transformative results. Support from donors, the private sector, international organizations and others will be needed for this to happen, and the 2019 forum should provide a venue to take stock of this. Similar results can be expected in relation to capacity-building, science, technology and innovation for Sustainable Development Goal road maps and the scale-up of indigenous/traditional knowledge.

101. The Technology Facilitation Mechanism is the multi-stakeholder platform in the United Nations system for advancing science, technology and innovation applications for the Sustainable Development Goals. Existing conferences and events within and outside the United Nations may be associated with and consider presenting their science, technology and innovation summaries to the forum. Other initiatives, such as the Technology Bank for the Least Developed Countries, are invited to connect in order to maximize their impact through the Delivering-as-one initiative.

Rapid technological change

102. Better knowledge and insights with regard to the impacts of new technologies are needed — in both developed and developing countries — in order to prepare for the different scenarios of how these impacts might unfold in the coming years. These would include supporting the capacities of developing countries to assess and prepare for their impacts, including through the dissemination of public policies and good practices. The United Nations would appear to be the appropriate global forum to deal with the topic.

103. Governments and all relevant stakeholders need to act proactively in the coming years, in order to realize the positive technology impacts and achieve the objective of the 2030 Agenda to leave no one behind.

104. Responsible and ethical deployment of technologies has to be balanced against concerns that "excessive" restraints on innovations, which might otherwise deprive humanity of many benefits. This requires pragmatic, evidence-based ethical assessments that must derive from the values contained in the Charter of the United Nations, the Universal Declaration of Human Rights, the outcome of the United Nations Conference on Sustainable Development (Rio+20) and the 2030 Agenda for Sustainable Development.

105. Extraordinary levels of international cooperation on research, infrastructure, access, and capacities are needed in order to overcome the technology gaps between and within countries, between men and women, and across social groups — ultimately to avoid long-run, low-technology traps. This requires multi-stakeholder approaches and United Nations system support.

106. Holistic, integrated approaches and strategies are needed. They should be conducive to a wide range of forms of knowledge and perspectives, including those

of young people, as well as local, traditional and indigenous forms of knowledge, and also supported by new and emerging technologies.

107. In a rapidly changing world, a forward-looking perspective is needed to understand the potential opportunities and challenges associated with the impact of rapid technological change on the achievement of the Sustainable Development Goals, including through the engagement of other existing forums and opportunities, such as the high-level political forum and the General Assembly.

Science, technology and innovation for Sustainable Development Goal road maps and action plans

108. The cross-cutting nature of science, technology and innovation and the Sustainable Development Goals requires holistic approaches and strategies. Multidisciplinary and integrated approaches are necessary to take into account different sources of knowledge, including local and indigenous knowledge.

109. Science, technology and innovation for Sustainable Development Goal road maps and action plans that aim to accelerate progress towards the Goals need to be developed at the national and subnational levels, ideally with measures for tracking progress and in line with national and global development strategies. Science technology and innovation for Sustainable Development Goal road maps can be strategic tools for ensuring policy coherence and linking with solutions, public policies and good practices.

110. Science, technology and innovation for Sustainable Development Goal road maps are most effective if built up with stakeholder engagement in science, technology and innovation policy design, adaptation and application. Public-private partnerships and other forms of collaboration should be fostered with scientists and engineers in companies at the technology frontier. "Deep dives" are needed for each Goal for which road maps could help prioritize actions and promote cross-sectoral collaborations, as was illustrated by the forum's dedicated sessions on Goals 6, 7, 11, 12 and 15.

111. It was suggested that a group of Member States could lead the way by undertaking serious efforts over the coming year to develop their own versions of science, technology and innovation for Sustainable Development Goal road maps and reporting on their experiences at the high-level political forum in 2019.

Investment, Governments and the private sector

112. More engagement is needed from science communities, funders, academia and the private sector. Public-private partnerships are essential for science, technology and innovation, as are other efforts that expand partnerships with the private sector for creating business opportunities in pursuing science, technology and innovation solutions for achieving the Sustainable Development Goals. Regardless of the model of involvement, a business case should be made for private sector investment in innovation for the Goals. Member States were also called upon to support the Technology Facilitation Mechanism, both politically and financially.

113. Strategies for fostering start-ups can be useful for crowdsourcing solutions to both economic and daily life challenges. In fact, existing technologies can solve many current needs, if matchmaking and scaling up can be facilitated, as was demonstrated in the forum's exhibitions and event on deploying, financing and scaling technologies. After its four-year cycle in 2019, the lessons learned should inform the progress towards multi-year sustainable solutions.

IV. Recommendations for the multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals

114. Going forward, the forum will continue to strengthen its convening power for dialogues between stakeholders and governments and for sharing ideas and catalysing new initiatives and partnerships. It will continue to help to identify practical means and solutions to foster science, technology and innovation in all countries.

Supporting an inclusive Technology Facilitation Mechanism

115. The high participation and engagement levels from a very diverse cross section of relevant parties showed that there is a real demand for the multi-stakeholder forum and its science-policy interface function in support of the Sustainable Development Goals. Given the high expectations for the Technology Facilitation Mechanism, Member States and stakeholders should consider strengthening their political and financial support for the Mechanism.

116. The multi-stakeholder Technology Facilitation Mechanism should improve inclusion of stakeholders and associated related events and improve coordination with United Nations system and international organizations. Support is needed for even greater participation in the forum by developing countries (e.g., government representatives and innovators) and the further development and operationalization of the Mechanism, including the full operationalization of the online platform, the work of the joint inter-agency task team and the inter-agency task team subgroups on science, technology and innovation for Sustainable Development Goal road maps and on rapid technology change and frontier technologies.

117. The forum should become more action-oriented and cumulative in its impact, including in the messages it provides to the high-level political forum. Over the coming 12 years, future forums should learn from and advance the achievements of previous ones. The forum should become the outcome of an annual programme of results-oriented activities and, as part of a series, provide a regular opportunity to collaboratively define priorities for action. The 10-member group and the inter-agency task team should further refine those objectives, develop specific actions and share progress on such actions to support the objectives. As proposed by the second forum, a road map for the Technology Facilitation Mechanism should be developed by the inter-agency task team and the 10-member group. The road map should also include details on associating key international events and meetings with the forum, in order to maximize the impact of the forum and to draw on key messages from different stakeholder communities.

Work of the Technology Facilitation Mechanism on rapid technological change

118. The inter-agency task team subgroup on rapid technology change and frontier technologies should disseminate information on and support the knowledge and understanding of science, technology and innovation trends, impacts, good practices, initiatives and public policies for the Sustainable Development Goals and their targets. A forward-looking perspective, coherent and plausible scenarios and more robust quantitative approaches can help in this effort. The information paper of the inter-agency task team on the subject could become a "living document", serving as an entry point to United Nations system, civil society, scientific and academic discussions on the topic.

119. The Technology Facilitation Mechanism should explore the building of partnerships and interfaces with universities, innovation incubators and private sector

entities that are at the forefront of technological change. This could be in the form of a "Sustainable Development Goal discovery lab" or a network of "science, technology and innovation centres for the Sustainable Development Goals" that could serve as a direct interface between the policy makers and technologists at the "frontier", facilitating the exchange of real-time information, engagement and policy insights.

Work of the Technology Facilitation Mechanism on science, technology and innovation for Sustainable Development Goal road maps

120. The work of the inter-agency task team subgroup on science, technology and innovation for Sustainable Development Goal road maps and action plans is encouraged, to support the development of multi-stakeholder science, technology and innovation action plans for implementing the Goals. International support, Member State engagement and partnerships with civil society and the private sector will be needed to develop capacities and to formulate science, technology and innovation for Sustainable Development Goal road maps at the national and subnational levels and to fill the critical gaps in data, finance and effective implementation. United Nations experts on the inter-agency task team, in the 10-member group and among Technology Facilitation Mechanism stakeholders constitute an important source of technical expertise in this respect.